



Reference Stations for an High Elevations (HE) Network

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HIGH ELEVATIONS NETWORK - *Introduction*



- Better comprehension of physical and dynamic processes in high altitude areas is one of the main aims of the CEOP-HE initiative.
- In this framework, collection of representative data becomes a key element and establishing mechanisms for coordination amongst high altitude stations is essential to the definition of an HE network.



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HIGH ELEVATIONS STATIONS - *Characteristics*


In selecting stations which can be considered HE reference stations, we must consider:

- ✓ elevation and topographic setting;
- ✓ available instrumentation;
- ✓ duration,
- ✓ calibration and maintenance protocols,
- ✓ homogeneity and completeness of data,
- ✓ regional coverage.
- ✓ ability of the station to sample the free troposphere
- ✓ equipped with high precision sensors and real-time data transmission systems



HIGH ELEVATIONS STATIONS – *Classification*

1. HE Weather Stations (AWS or synoptic stations)
2. HE Observatories (full-scale scientific observatories)
3. HE Research Stations (AWSs operational for a limited time)

HE RSs  "HE Observatories" category

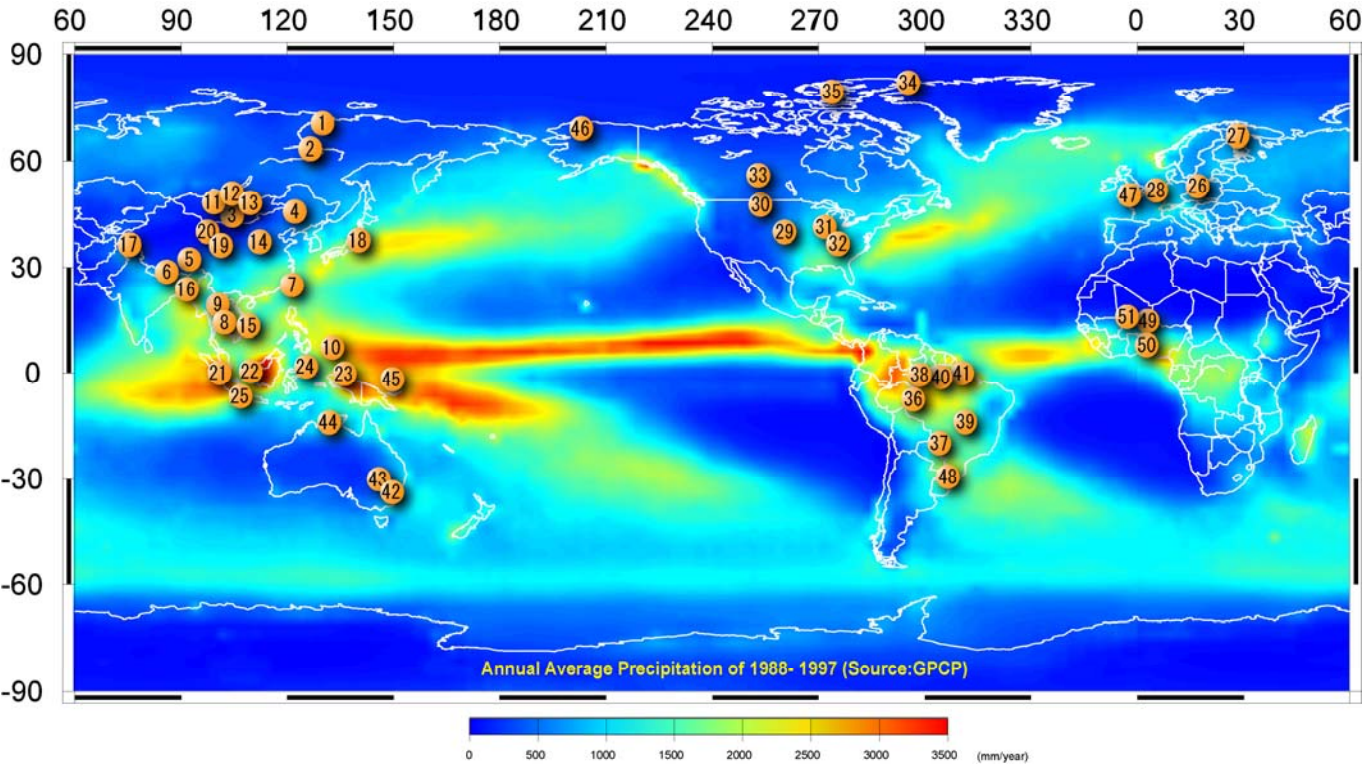
to guarantee high quality data and long term continuous measurements



CEOP Network



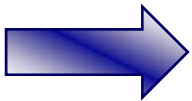
51 stations



Measurements

- Surface meteorology and radiation
- Heat and CO₂ fluxes
- Soil temperature and soil moisture
- Tower meteorology

CEOP HE STATIONS



1. CAMP Tibet
2. CAMP Himalayas
3. Pakistan Karakorum Network

Ev-K2-CNR - CEOP HE AWSs IN HIMALAYA AND KARAKORUM



SHARE
Stations at High Altitude for Research on the Environment



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Ev-K2-CNR - CEOP HE AWSs MEASUREMENTS



Standard stations

Parameter	Unit of measurement
Temperature	° C
Relative Humidity	%
Pressure	hPa
Global solar radiation	W m ⁻²
Wind speed	m s ⁻¹
Wind direction	<
Precipitation	mm

Additional measurements

Parameter	Unit of measurement
Snow level	m
Soil heat flux	W m ⁻²
Soil temperature	° C
Premitivity	%
USW radiation	W m ⁻²
ULW radiation	W m ⁻²
DSW radiation	W m ⁻²
DLW radiation	W m ⁻²

Nepal

- ▶ Lukla
- ▶ Namche
- ▶ Pheriche
- ▶ Pyramid

Pakistan

- ▶ Askole
- ▶ Urdukas

Nepal

- ▶ Pyramid
- ▶ Lukla

CEOP HE AND SHARE PROJECT

The CAMP Himalayas (*Pyramid, Pheriche, Namche and Lukla*) and Pakistan Karakorum Network (*Askole and Urdukas*) are managed by the *Ev-K2-CNR Committee*, the organization at the head of the *CEOP-HE* working group and creators of the *SHARE (Stations at High Altitude for Research on the Environment)* Project.

SHARE within its network **environmental monitoring** is carried out in **high altitude** areas in the fields of **Environmental and Earth Sciences** (atmosphere and climate changes, glaciology, hydrology and limnology in high altitude areas, geophysics and natural hazards). The main goal of **SHARE** is to contribute to the study of **climate change impacts and adaptation strategies**, with special attention to water resources, biodiversity and ecosystem conservation and food security.

The project also aims to make new and more complete **information** on climate changes and their local, regional and global consequences available to **governments and international agencies**.



SHARE STATIONS



Installation site	Nation/Continent		Station	Characteristics	Altitude (m a.s.l.)
Mt. Cimone	Italy	Europe	“Ottavio Vittori” Research Station:	Atmospheric monitoring station	2,165
Forni glacier	Italy	Europe	-	Automatic weather station	2,669
Pyramid Laboratory Observatory (Lobuche)	Nepal	Asia	Nepal Climate Observatory- Pyramid (ABC-Pyramid)	Atmospheric monitoring station	5,079
			GPS Master	GPS station	5,050
			AWS 0, AWS 1; AWS CEOP	Automatic weather stations	5,050
			DORIS	Orbitographic station	5,050
Pheriche (Khumbu Valley)	Nepal	Asia	AWS 2	Automatic weather station	4,258
Namche Bazar (Sagarmatha National Park Head Quarter, Khumbu Valley)	Nepal	Asia	AWS NP	Automatic weather station	3,560
Lukla (Khumbu Valley)	Nepal	Asia	AWS 3	Automatic weather station	2,660
Kala Patthar	Nepal	Asia	AWS-KP	Automatic weather station	5,600
Mt Everest South Col	Nepal	Asia	AWS-CS	Automatic weather station	8,000
Urdukas (Baltoro glacier, Baltistan)	Pakistan	Asia	AWS PK1	Automatic weather station	3,926
Askole (Baltistan, Pakistan)	Pakistan	Asia	AWS PK2	Automatic weather station	3,015
Mt. Rwenzori (Elena Glacier)	Uganda	Africa	-	Automatic weather station	4,700

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STATION MANAGEMENT : OPERATION AND MAINTENANCE OF INSTRUMENTS AT HIGH ALTIUDE

Technology:

- mostly same sensors, customized if needed for use at very low temperature and low atmospheric pressure
- Renewable power supply system

Logistic aspects

- Alpine guides support
- Instrumentation transport
- local technicians training for ordinary maintenance
- QA/QC protocols for stations management
- periodic field campaign for special maintenance operations and instrument calibration
- activation of satellite data transmission and instrumentation remote control system



MODULAR APPROACH

- *HE RS network (HE observatories, where possible) will include not more than 10-12 stations*
- *Other HE stations (AWSs) representative of the surrounding area would also be considered (max. 20-30)*
- *A coordinated global HE monitoring network will be set up, ensuring uniform data where possible and encouraging the establishment of CEOP-HE sites in poorly represented areas.*
- *New sites in the HE network may include, but would not be limited to, officially recognized CEOP RSs.*

NEXT STEPS

- identify key high elevation monitoring sites where physical and dynamic processes are studied, collect information on the sites and invite site managers to become part of the CEOP-HE network;
- install new observatories in significant but previously unrepresented HE areas when possible;
- create a database of HE stations worldwide;
- develop CEOP-approved installation procedures and long-term maintenance guidelines for HE sites and QA/QC policies for data acquisition;
- produce high-quality datasets in line with the CEOP data policy.

THANKS FOR YOUR ATTENTION



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